

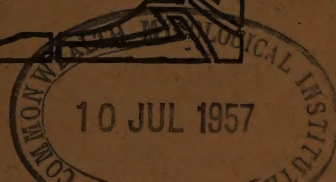
Vol. 32 Parts 3-4.

Rubber Research Institute of Ceylon

Combined 3rd & 4th Quarterly Circulars
for 1956



January, 1957



Rubber Research Institute of Ceylon

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N O T I C E S

DARTONFIELD GROUP—VISITORS' DAY

Those who wish to visit the Institute are requested to do so after making an appointment. No special days are set apart as Visitors' Days and the services of the technical officers can be availed of for discussion or demonstration only by prior appointment.

PUBLICATIONS

Rubber Research Institute publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agent of rubber estates in Ceylon over 30 acres in extent. Advisory Circulars and Small holdings Leaflets in English or Sinhalese will be available without charge to Smallholders on application. Forms of application can be supplied on request.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Circulars may be obtained on application at 30 cents per copy. Future issues in the series will be sent free of charge to estates and smallholders registered for the receipt of our publications:—

- (5) Straining box for latex (January, 1940).
- (12) Warm Air Drying House for Crepe Rubber (Reprinted 1952).
- (19) Density of Planting and Thinning out (December, 1942).
- (33) Mechanical Felling of Rubber Trees (Reprinted March, 1955).
- (36) Contour Lining, Holing and Filling, Cutting of Platforms, Trenches and Drains (Superseding Circular No. 4) (February, 1953).
- (37A) Manuring—Magnesium Deficiencies in Rubber (July, 1954).
- (37B) Potassium Deficiencies (September, 1954).
- (38) Planting and After Care of Budded Stumps and Stumped Budgrafts (Superseding Circular No. 8) (March, 1953).
- (39) Clonal Seed as Planting Material (Superseding Circulars No. 26 and 27) (July, 1953).

- (40) Tapping of Hevea Rubber (Superseding Circulars No. 17 and 34) (June, 1954).
- (41) Pink Disease (June, 1954).
- (42) Sale of Budwood (June, 1954).
- (42A) New Local Planting Material for Small Scale Trials on Estates (July, 1955).
- (43) Oidium Leaf Disease (Superseding Circulars No. 22 and 28) (June, 1954).
- (44) Diplodia Dieback and Collar Rot of Hevea and Blue Spot of Crepe Rubber (June, 1954).
- (45) Phytophthora Leaf Disease and Stem Dieback of Hevea (October, 1954).
- (46) White Root Disease of Hevea (Leptoporus Lignosus=Fomes Lignosus) (October, 1954).
- (47) Ustulina Rot of Rubber Trees (November, 1954).
- (48) Brown Root Disease of Hevea (October, 1954).
- (49) Root Disease in Replanted Areas (Superseding Circular No. 31) (October, 1954).
- (50) Orange Gall of Hevea (December, 1954).
- (51) Bird's Eye Leaf Spot of Hevea (December, 1954).
- (52) A Guide to the Cost of Replanting Rubber (December, 1954).
- (53) Prevention of Coagulation in the Field (Superseding 2nd Supplement to Advisory Circular No. 17) (March, 1955).
- (54) Bark Rot and Canker of the Rubber Tree (Superseding Circular No. 21) (July, 1955).
- (56) Cover Crops (Superseding Circular No. 25) (October, 1955).
- (57) Notes on Rubber Seedling Nurseries (Superseding Circular No. 35) (October, 1955).
- (58) Notes on Budgrafting Procedure (Superseding Circular No. 1) (December, 1955).
- (59) Manuring of Rubber (Superseding Circular No. 37) (June, 1956).

CLONE LCB. 1320

The owners of the above clone (Government Agricultural Enterprises, 29, Djalan Imam, Bondjol, Djakarta, Java) have authorised the re-sale of material of this clone in Ceylon without agreement with effect from 1st January, 1957.

The agreements already signed in respect of budwood of this clone purchased from this Institute should therefore be regarded as cancelled in so far as re-sale within Ceylon is concerned.

RRIC. CLONES.

It is hereby notified that the clones developed by this Institute, which were hitherto known as RLD clones, will in future be known as RRIC clones.

PACKAGING AND MARKING R.S.S. BALES—I. BALE COATING COMPOSITIONS—A PRELIMINARY REPORT

By

E. J. Risdon

*(Chemist and the Staff of the Chemical Dept.)**

1. Introduction:

This article which deals with R.S.S. bale coatings was issued with only minor amendments as Information Leaflet No. C/56/2 to Colombo and Galle Packers and Shippers either direct or through the R.T.A. of Colombo. As the implications of this subject are of considerable interest to all concerned with the raw rubber production industry in Ceylon, additional copies of the leaflet were despatched to various Government Departments, the P.A. of Ceylon and to the L.C.P.A.

The early history of the packaging of R.S.S. will be well known to Packers in Ceylon and is summarised in much of the relevant technical and semi-technical literature (2, 3, 4, 9, 10, 11) so that for the purpose of this article it is only necessary to mention that the present almost, if not entirely, one hundred per cent use of bare-back baling for R.S.S. has been traced *inter alia* to the technical difficulties involved in the use of wooden containers, *i.e.* to storage difficulties and to the splintering of the wood into the rubber in the many cases of serious damage to the containers etc., to the immediate post-war shortage of alternative packaging material, *i.e.* wood and burlap for example, to the relative cheapness of the raw materials involved and to the simplicity and general acceptability of good quality bare-back baling. While it seems unlikely that any alternative system of packaging R.S.S. will be introduced on a very large scale in the near future, it is apparent from the technical literature and from the correspondence available to the R.R.I.C. that present day commercial bare-back baling is not invariably satisfactory and this article deals with one aspect of this subject primarily with reference to Ceylon.

2. Bare-back Baling:

The commercial requirements of the bare-back baling of R.S.S., that is the packaging of the appropriate weight and quality of R.S.S. inside suitably treated R.S.S. of the same quality, are somewhat severe and various aspects of this subject have been discussed in the literature (1, 3, 4, 5, 6, 8, 9, 11). Ideally, bare-back baling must fulfil at least the following conditions: (a) the raw materials and the procedure involved must be inexpensive, (b) the bales formed must be rigid and substantially undeformed at the completion of shipment and storage, (c) the bale contents must be adequately protected from contamination in the form of dirt, moisture, etc., (d) the bales must not mass nor adhere to each other during shipment or storage, (e) the wrapper sheets must be easily removable to permit ready sampling and inspection of the bale contents, (f) the bale markings must be permanent and legible and (g) neither the coating nor the marking materials used may present the consumer with processing, storage or other difficulties.

* D. S. Muthukuda

Information supplied in 1951 by one of the advisers of The R.T.A. (London) Joint Committee on Marking and Packing Baled Rubber made it quite clear that users of natural rubber had at times ample grounds for complaint against the bare-back baling of at least certain suppliers of R.S.S. Pertinent comments on the nature and seriousness of these complaints were made in the 1951 Report (7) of the Superintendent of the London Advisory Committee for Rubber Research and extracts from this report were later circulated to Packers in Ceylon. In order to obtain information on bare-back baling procedures used in Ceylon, a questionnaire was despatched in 1951 to the principal Packers in Colombo and Galle and the replies received suggested that, although certain Packers were perhaps not entirely satisfied with the procedures used, surprisingly few complaints had been received. There was also a strong implication that the apparent relatively good performance of Ceylon R.S.S. bales might be attributed in part at least to the fact that Colombo was largely a 'topping up' rather than a 'filling up' port, so that Ceylon rubber was not generally stowed upto 16 to 20 bales deep in the holds. More recent information seems to imply that this suggestion may have been at least partially correct.

While Packers in Ceylon may wish to view the above situation with complacency the complaints received from the People's Republic of China regarding the legibility of marks on bare-back R.S.S. bales shipped under conditions where Colombo is a 'filling up' port and the relatively recent complaints from non-Asiatic buyers make it quite clear that all is not invariably well with Ceylon's R.S.S. packaging procedures. For the purpose of this article it will be assumed that complete or substantial illegibility of R.S.S. bale marks in ordinary as opposed to U.V. or 'dark' light can arise through substantial distortion of the bales during shipment or storage, the use of paints which flake off with, for example, change in temperature or abrade off or smear due to mechanical forces, *e.g.* bale slippage or sliding, the use of paints which wash off or smear in accidental contact with water (*i.e.* rain water, sea water, melted ice, snow or hail, etc. during loading, unloading or in transit, and condensate resulting from temperature differentials at sea or during unloading), the use of coatings which flake off in lumps or abrade off as a dust removing or obscuring the superficial paint layer, or through the use of coatings which pick up excessive amounts of dirt. The subject of the paints is dealt with in a subsequent article, the subject of distortion due to inadequate pressing is beyond the scope of both articles and only the subject of bale coatings is mentioned herein.

3. Ingredients of Coatings :

The 1954 edition of the 'Green Book' (Type Descriptions and Packing Specifications for Natural Rubber, adopted by the R.M.A. Inc. of New York and endorsed by the R.T.A. of New York Inc.) requires the bale coatings to consist of a natural rubber binder solution to which is added an approved filler or powder and lays down in considerable detail the procedure to be followed. However, an examination of the coatings used commercially in a number of Packing Houses makes it reasonably clear that some of these coatings have not been made according to the procedures of the R.M.A. and this viewpoint has been confirmed on a commercial scale by the shipment of small lots (30-50 bales) made according to R.M.A. procedures for comparison by the buyer with the bulk of the consignment. Bearing in mind the criteria of bare-back baling and of bale coatings implied or discussed in the previous section it will be apparent that it is not necessarily sufficient to take an unknown or unweighed amount of an available cheap white filler and add this to an inhomogeneous natural rubber solution whose content of rubber is not known and whose 'solvent power' is inadequate for 'binding' purposes.

Dealing firstly with the powder used, it will be apparent that the minimum technical requirement on a commercial scale is that the powder used shall be of the approved type and that the coating shall pass the R.M.A. milling conformance test. The section of the 'Green Book' dealing with powders requires the powder used to be white and water insoluble, to disperse uniformly and without agglomeration upon milling, to have a specific gravity in the range 2.60-3.00 and to have a particle size distribution such that when washed through the appropriate sieves there shall be 100 per cent penetration through the standard U.S. sieve No. 100 and 93 per cent penetration through the standard U.S. sieve No. 325. Of the powders considered suitable, provided that they meet the above requirements, at least two-talc and whiting chalk or English white—are usually readily available through the relevant importers. Packers may wish to suggest that, based on previous performance and on the possibility that the shipping lines may dust the bales with non-conforming powders, exact adherence to the particle size specification is unnecessary. While a certain measure of latitude might be justified on the basis of the milling conformance test alone, Packers should appreciate that the R.M.A. powder specification is not a tentative specification and that the 'Green Book' clearly requires conformance except with the prior approval of the buyer. Various laboratory tests have been made outside Ceylon to determine the relative merits of certain of the approved powders from the viewpoints of adhesion of the coating to rubber, of protection against dirt pick-up and of the prevention of the self-adhesion of rubber with coating interlayers (4). While the information may not be entirely conclusive there are indications that the R.M.A. talc coating can be at least slightly better than the R.M.A. whiting chalk coating for both the prevention of self-adhesion of rubber (bales) and for adhesion to the rubber (wrapper). As far as is known talc is the preferred powder in Ceylon, but small scale shipments (30-50 bales scale) of R.S.S. bales coated to R.M.A. formulae with whiting chalk of the appropriate particle size distribution have been made with the assistance of the R.R.I.C. and the buyer's reports on the manufacturer's comments do not suggest dispersion difficulties. It is understood that English white is used rather more extensively outside Ceylon so that, if this imported powder is still available with the correct particle size distribution and at a suitable price, further trials by Packers might be worthwhile. It should be noted in this connection, however, that one Packer in Ceylon has implied that, under his conditions, whiting chalk coatings do not readily take water-based stencil marks. The R.R.I.C. does not wish to comment on this point as water-based stencils are not considered entirely satisfactory.

Dealing secondly with the constituents of the binder solution, it will be apparent that the primary objective of the binder is to hold the selected powders in place on, and evenly distributed over, the outer surface of the wrapper without interfering in any way with the dispersibility of the powder or producing a tacky coating which promotes bale massing in transport or storage. For this purpose the 'Green Book' specifies natural rubber as the base material, and binders based on starchy material such as sago, as used by one Packer in 1951, are expressly forbidden except with the buyer's approval. The solvent used should not be unnecessarily hazardous from the fire risk viewpoint but should, in technical parlance, be a 'good' solvent for rubber, so that a homogeneous solution of natural rubber in the solvent is readily prepared and so that the adhesion of the coating to the bale is increased by the softening action of the solvent on the wrapper. The relevant section of the 'Green Book' reads as follows:—

'The solvent that must be used (previously specified in R.M.A. packing specifications as mineral turpentine) is a hydrocarbon of petroleum distillate having a distillation range of 290°F to 410°F. The specific gravity at 60°F ranges from 0.766 to 0.830. The flash point in a closed cup ranges from 90°F to 105°F.'

One of the cheaper locally available solvents intended to meet the above specification is low aromatic white spirit which was retailed (Nov. 1955) in small lots at Rs. 3/15 per gallon and in 40 imperial gallon drums at Rs. 2/40 per gallon. However, the R.R.I.C. is well aware that many Packers consider the use of solvents supplied to the above specification to be an unjustified expense.

Finally, it is necessary to consider the ratio of the ingredients—powder, rubber and solvent—to be used in the coating and it is the present opinion of the R.R.I.C. that the (visually) relatively poor quality of a number of the bare-back bale coatings in Ceylon Packing Houses can be attributed in part at least to the use of incorrect or inadequately controlled mixtures and procedures for the preparation of the coating solutions. While the contents of the 'Green Book' seem to imply a considerable measure of latitude in this connection, it is to be expected that, for example, the use of an excess of powder with a deficiency of rubber and a relatively 'poor' solvent can readily produce powdery, uneven coatings; whereas an excess of rubber might readily produce coatings which are too soft or at worst poor on anti-massing properties. Similarly, a deficiency of solvent, particularly when a 'poor' solvent is used, might be expected to tend to produce solutions which are difficult to apply in practice; whereas an excess of solvent might require a double coating. In the latter connection it should be remembered that, apart from the additional labour cost, double coating is not permitted according to the 'Green Book' and has been criticised in the literature (4) on the grounds that a double coating is not as effective in preventing adhesion between the bales as a single coating of the same thickness.

4. The Preparation of Bale Coating Solutions Using R.M.A. Type Solvents:

The importance of the proper selection of the ingredients of the bale coating solution has been discussed in the previous section so that it would be appropriate to describe in detail the preparation of bale coating solutions. The recipe given by the R.M.A. requires the addition of upto 48 lbs. of approved powder, or less depending upon the weight per unit volume, and of 4 U.S. gallons of the solvent to each 16 lbs. of the natural rubber binder solution, which is made up in the proportion of $\frac{1}{2}$ lb. of clean natural rubber to each 1.5 U.S. gallons of the solvent. In order to eliminate the necessity of weighing the binder solution, the R.R.I.M. have suggested (11) the following procedure:—Weigh out $\frac{3}{4}$ lb. of crepe or clean R.S.S. and cut into small lumps, stand this rubber for at least 24 hours in 10 imperial pints of solvent. Then add a further 5 imperial pints of solvent and stir or shake until all the rubber is dissolved. Add 26 imperial pints of solvent and stir until the solution is homogeneous, finally adding with stirring upto 48 lbs. of approved powder. The final solution is a paste which should be applied vigorously with a stiffish brush.

However, Heinisch has suggested (4, 6) that the R.M.A. coating mixture contains too much powder and too little rubber implying that the final bale coating made with talc may be sufficiently powdery or dusty to cause serious obscuration of the bale marks and, as noted on page 17 of the 1954 edition of the 'Green Book', the R.R.I. of Indonesia has reported satisfactory results by increasing the proportion of rubber to solvent in the R.M.A. natural rubber binder solution from $\frac{1}{2}$ lb. of rubber to every $1\frac{1}{2}$ U.S. gallons of solvent to $\frac{1}{2}$ lb. of rubber per 1 U.S. gallon of solvent, the final bale coating solution being made by adding 4 U.S. gallons of solvent and only 27 lbs. of powder to every 16 lbs. of the modified binder solution. The various procedures are summarised in Table No. I below which gives the amounts of the ingredients employed in the final bale coating solution on the assumption that $\frac{3}{4}$ lb. of rubber is used as binder base.

Table No. 1.

No.	Type.	Ozs. of N.R.	U.S. gallons Solvent.	Lbs. of Powder.
1	R.M.A./R.R.I.M. (11)	12	$\sim 6 \frac{1}{4}$	Upto 48
2	R.R.I. Indonesia (4)	12	$\sim 4 \frac{1}{5}$	~ 18
3	R.R.I.C.	12	$7 \frac{1}{8}$	$42 \frac{3}{8}$

Solution No. 3 of Table No. 1 is based on the use of low aromatic white spirit. The recipe given contains rather more solvent and less powder than the R.M.A./R.R.I.M. mixture and appears, under our conditions, to be slightly more satisfactory on the basis of ease of preparation and application of the solution and of visual appearance of the dried coating. It would, however, be incorrect to presume at this stage that this is necessarily the most suitable recipe with this solvent; nevertheless, as stated previously, small scale shipments and the opinions of Packers in Ceylon, who have seen finished coatings in their Stores, clearly suggest that this mixture with approved whiting chalk or talc as powder is a marked improvement on the standard commercial output of a number of Packing Houses. The detailed procedure and some of the precautions necessary for making up and using the coating are given below:—

Weigh out 9 ozs. of clean crepe and cut into small pieces about $\frac{1}{4}$ " square. Add these pieces to 1 U.S. gall. [3.78 litres, 6.66 ($6 \frac{2}{3}$) imperial pints] of low aromatic white spirit in a suitable container which should be covered or corked. Allow the mixture to stand undisturbed either overnight or for 24 hours; at the conclusion of this period it should be well stirred at intervals over 2 hours. Under our conditions 3 minutes stirring every 30 minutes of the 2 hours is adequate provided any lumps at the bottom of the container are agitated. At the completion of this stirring add a further $\frac{1}{2}$ U.S. gallon (1.89 litres, $3 \frac{1}{8}$ imperial pints) of solvent and restir for 2 minutes. Cover the container and allow the mixture to stand either overnight or for a further 24 hours. At the end of this period the mixture is usually a uniform solution of rubber in the solvent, *i.e.* without lumps of swollen or inadequately dispersed rubber; and, if the rubber is not properly dispersed, the solution must be well stirred to complete the dispersion. When the dispersion is complete a further 4 U.S. gallons (15.12 litres, $26 \frac{2}{3}$ imperial pints) of low aromatic white spirit and 32 lbs. of talc or whiting, supplied to the appropriate specification, is added. This addition is best accomplished by adding the extra solvent and the pigment in small lots of, say, about $\frac{1}{2}$ U.S. gallon (1.89 litres, $3 \frac{1}{8}$ imperial pints) and 4 lbs. of powder and stirring well after the addition of each charge. Addition of all the powder and the solvent need not take more than about $\frac{1}{2}$ hour. After the completion of these additions the whole mixture should be stirred continuously for about 1 hour, particularly if talc is used, in order to 'wet out' the powder. This bale coating stock solution is normally ready for use the following day. As the powder does not necessarily remain uniformly dispersed in the stock solution, the latter should always be well stirred before drawing off samples for use and the operatives who apply the coating solution should be instructed to keep their pots well stirred. It should also be noted that as the solvent used is not substantially involatile all containers should be kept stoppered or covered whenever possible.

5. The Preparation of Bale Coating Solutions Using Diesoline A.G. :

The previous section contains a detailed description of the manufacture of the R.M.A. bale coating solution and of a solution based upon the low aromatic white

spirit available in Ceylon. While a coating involving slightly less solvent and powder might be as satisfactory as the latter solution, this solution appears to be appreciably less powdery and, in general, more easily applied than the R.M.A./R.R.I.M. formulation when the latter is based on low aromatic white spirit and, as noted above, has been favourably commented upon in Colombo from the viewpoints of appearance of the finished coating and of ease of application. Bale coating solutions based upon low aromatic white spirit have, however, been extensively criticised by Packers in Ceylon, (where the cost of the raw materials for bale coatings form an appreciable part of the total operating costs), on the grounds of the high price of the solvent involved and the R.R.I.C. has therefore carried out a preliminary laboratory scale examination of a number of formulations based upon diesoline A.G. Typical diesoline based recipes with relevant comments on the dried coatings, etc. are given in Table No. II, and it should be noted that in our opinion *none* of these recipes appear, on the basis of visual examination of the dried coating, to be as satisfactory as properly designed formulations based upon low aromatic white spirit, although an appreciable number of them are a marked improvement over the commercial coatings seen in a number of Packers' Stores. The recipes given in Table No. II involve the use of $\frac{3}{4}$ lb. of clean crepe and of powders passing the R.M.A. particle size (sieve) specification.

Table No. II

No.	Ozs. of Crepe	U.S. galls. Solvent	Powder in Lbs.		Comments on the Dried Coatings, etc.
			Talc	Whiting chalk	
4	12	6 $\frac{1}{4}$	48	—	Coating powdery, solution too stiff.
5	12	6 $\frac{1}{4}$	—	48	Better than No. 4.
6	12	6 $\frac{1}{2}$	36	—	Considered to be the best talc recipe tested.
7	12	6 $\frac{1}{2}$	—	38 $\frac{1}{2}$	Considered to be the best whiting chalk recipe tested.
8	12	5 $\frac{1}{2}$	27	—	Coating similar to 6, but see note (b).
9	12	5 $\frac{1}{2}$	20	—	Coating probably too thin on the rubber.
10	12	4 $\frac{1}{5}$	27	—	Coating powdery.
11	12	4 $\frac{1}{5}$	24	—	Coating similar to 6, but see note (b).
12	12	4 $\frac{1}{5}$	18	—	Coating very adhesive but probably rather thin on the rubber.
13	12	4 $\frac{1}{5}$	—	27	Coating similar to 7, but see note (b).
14	12	4 $\frac{1}{5}$	—	18	Probably too thin on the rubber.

Notes.—(a) In general whiting chalk (English white) tended to adhere more firmly than the corresponding talc recipe producing a smoother surface on which penetrating paints tend to dry rather more slowly.

(b) The coatings obtained from recipes No. 8 and 11 appear to be similar to that obtained with recipe No. 6, but the latter is preferred on the grounds that inadequate stirring of the containers at the time of application is less likely to produce coatings similar to those obtained with recipe No. 9. The same comments apply in the comparison of recipes No. 13 and 7.

The information summarised in Table No. II is in agreement with the views that when diesoline A.G. is used as solvent the best results, *e.g.* recipe No. 6, may be obtained when the quantity of filler powder is appreciably less than the maximum permitted in the official R.M.A. coating solution. It will also be noted that the data do not support the view that the production of the coating solutions should be left to an untrained labourer with inadequate means of weighing and of measuring the ingredients involved. The procedure employed in making up the solution according to recipe No. 6 is given at the end of this section and it is suggested that Packers wishing to use diesoline A.G. should at least try this method and should not employ excessive amounts of powder inadequately dispersed in the binder solution. This suggestion should not be interpreted to imply that the R.R.I.C. wishes to encourage the use of diesoline A.G., as this solvent would not be expected on theoretical grounds to be as suitable as low aromatic white spirit, does not comply with the R.M.A. specification and upto the present has not been found to be as satisfactory, on the basis of visual appearance and manual manipulation of the dried coating, as appropriate solutions based upon low aromatic white spirit. The R.R.I.C. does, however, wish to imply that if Packers really consider that present circumstances require the use of a cheaper solvent such as diesoline A.G., then every effort should be made to ensure that the best results are obtained from this solvent by using the optimum proportion of the various ingredients and a reliable method of preparation and application.

Bale coating solutions made according to recipe No. 6 of Table No. II have been applied for demonstration purposes to a number of bales in Packing Houses in Colombo and Galle and the procedure used and some of the precautions necessary in the preparation and use of this recipe are as follows:—

Weigh out 300 gms. ($\sim 10\frac{1}{2}$ ozs.) of clean crepe and cut into small pieces about $\frac{1}{4}$ " square. Add these pieces to 1 U.S. gallon (3.78 litres, $6\frac{2}{3}$ imperial pints) of diesoline A.G. oil in a suitable container which should be well corked. Allow the mixture to stand overnight; at the conclusion of this period it should be well stirred for about 5 minutes, and a further $\frac{1}{2}$ U.S. gallon (1.89 litres, $3\frac{1}{2}$ imp. pints) of solvent is added. Stir again for a period of 2 to 3 minutes once in about every 2 hours of each working day. At the end of 3 days, the rubber particles should be completely dissolved with the formation of a homogeneous rubber solution. If the rubber has not dissolved, the solution must be well stirred to complete the dissolution. When this stage is completed a further ca. $4\frac{1}{4}$ U.S. gallons (16 litres, $28\frac{1}{2}$ imp. pints) of the solvent are added with 32 lbs. of approved talc. This is best accomplished by adding small lots of, say, about $\frac{1}{2}$ U.S. gallon and 4 lbs. of talc and stirring well after the addition of each batch. Hand-squeezing of the mixture will usually hasten the dispersion. After all the solvent and pigment has been added the whole mixture is stirred continuously for 6 to 8 hours and is generally ready for application after a further 1 to $1\frac{1}{2}$ days standing. Before drawing off samples for use, the mixture should, however, be restirred for a short time. When approved whiting chalk is used in place of approved talc 34 instead of 32 lbs. of the pigment is taken, and the final dispersion may require $1\frac{1}{2}$ to 2 days rather than 1 to $1\frac{1}{2}$ days.

It seems appropriate to mention here that while the preparation of small separate lots of homogeneous bale coating solutions is a lengthy and unduly expensive procedure, the labour cost per unit weight or volume of solution will be greatly reduced if the work is adequately organised, *e.g.* on a large scale and so that several batches are in different stages of preparation at any one time.

6. Summary and Comments:

This article summarises some of the commercial requirements of the bare-back baling of R.S.S., notes that in recent years a number of complaints have been received concerning the illegibility of the marks on Ceylon's R.S.S. bales and draws attention to a number of the factors which might lead to valid complaints of this nature. The importance of the quality and type of the individual ingredients and of their relative proportions in the 'binder' solution and in the final bale coating solution is discussed and it is suggested that the apparent poor quality of a number of coatings seen in Packing Houses is attributable, in part at least, to failure to follow the appropriate specifications. Directions are given for the preparation and use of a bale coating solution, which is based on the employment of a locally available solvent (low aromatic white spirit, which is reported to meet the R.M.A. specification), and the final coating obtained is considered to be a marked improvement on many commercial coatings seen in Colombo. The objection that the cost of the solvent forms an unduly high proportion of the total operating costs of companies involved solely in grading, packaging and shipping rather than in the manufacture of R.S.S. has led to an examination of the possibilities of the use of diesoline A.G. as solvent. The evidence available does not support the view that even properly formulated bale coating solutions based upon diesoline A.G. will be as satisfactory, *e.g.* in adhesion to the wrapper etc., as properly formulated solutions based upon solvents meeting the R.M.A. specification. However, as a number of the better diesoline based coating solutions give coatings which appear to be more satisfactory than some commercial coatings seen in Packers' Stores, directions for the preparation and use of such solutions are included. It should not, however, be assumed that the use of technologically poor solvents such as diesoline A.G. is recommended. Subject to prior commitments, the appropriate Department of the R.R.I.C. will, where necessary and under the normal terms of reference, endeavour to inspect and advise upon Packers' normal procedures at their Stores.

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PACKAGING AND MARKING R.S.S. BALES—II. BALE MARKING PAINTS, A PRELIMINARY REPORT

By

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1. Introduction:

This article which deals with R.S.S. bale marking paints is based upon Information Leaflet No. C/56/3 which was issued in 1956 to Colombo and Galle Packers and Shippers either direct or through the R.T.A. of Colombo. Additional copies were also issued to various Government Departments, to the P.A. of Ceylon and to the L.C.P.A. The previous article in this series, which dealt primarily with R.S.S. bare-back bale coating compositions, implied that, following the relatively recent complaints received from the People's Republic of China regarding the legibility of bale marks, it could not necessarily be assumed that the packaging procedures employed in Ceylon were invariably satisfactory. At the same time a number of the factors which might contribute to the illegibility of the bale marks were mentioned including *inter alia* the use of bale marking paints which flake off with, for example, change in temperature or which abrade off or smear due to the action of mechanical forces, *i.e.* during bale slippage, sliding or distortion, or due to accidental contact with moisture or with rain or sea water. Mention was also made of the possibility that poor quality bale coatings might abrade off the outer wrapper taking the superficial paint layer with them or might powder off resulting in at least a partial obscuration of the bale marks.

2. Recent Developments in Marking Paints:

From the foregoing comments and from general principles it might reasonably be assumed that water dispersible paints or inks, particularly when applied over a poor quality bale coating, should not necessarily be expected to give the best results, and, although water dispersible ink were used quite extensively in Ceylon in 1951, they have been criticised in the literature on the grounds that they are neither as adherent nor as vivid as might be desired. The 1952 edition of the 'Green Book' of the R.M.A. (4) requires the use of dyes or pigments dispersed in a solution of natural rubber in mineral turpentine or kerosene. The R.R.I. of Malaya carried out fairly extensive tests with paints of this nature and found them to be superior to the water dispersible paints in general use. Dispersion of the pigment in these bale marking paints is not easy unless the pigment is milled into the rubber prior to the dissolution in the solvent and, according to the literature, it is questionable whether even these paints are entirely satisfactory. More recently, Heinisch and Wargadiwidjaja have noted (2) that certain commercially available fat soluble dyestuffs possessed the property of diffusing through the bale coating into the rubber forming the outer wrapper sheets and these authors developed a number of bale marking solutions incorporating such penetrating dyestuffs. The recipes suggested

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by Heinisch and Wargadiwidjaja (2) frequently required the use of rather inflammable solvents as well as the use of certain not very readily available constituents and were therefore simplified by Best and Lui (1) and tested in small scale trial shipments to Europe primarily with reference to the T.C.R. marks. As far as is known the R.M.A. has given its tentative approval to the judicious use of paints based on natural rubber solutions and incorporating conventional penetrating type dyestuffs for R.S.S. bare-back bales. Paints incorporating penetrating type dyestuffs should not be used, even on an experimental scale, for all other types of natural rubber, particularly not for latex crepes, air-dried sheet nor for Estate brown thin crepes, without the prior approval of the buyer. It is assumed that the implication behind the use of penetrating type dyestuffs in natural rubber solution is that, whereas water dispersible paints can be readily smeared in the presence of moisture, paints based on the use of natural rubber solution will largely resist this type of distortion and, by virtue of the 'keying' action of the solvent and the presence of the rubber to give a coherent film, will be expected to be substantially more abrasion resistant. If in addition a penetrating type dyestuff is incorporated in the natural rubber solution the adhesion might reasonably be expected to be improved even further, and in the event of almost complete erasure of the surface film of natural rubber and non-penetrating pigment a suitably coloured mark may still be observed, at least under certain circumstances. The latter claim can be readily demonstrated in a number of cases by applying the paint containing a penetrating dyestuff to the surface of a dried and coated bale, allowing the paint to remain undisturbed for at least a week and then attempting to remove the coating and paint films with a blunt knife, when the colouration of the R.S.S. due to a penetrating dyestuff will become apparent if the wrapper is held up to the light.

The procedures suggested by Best and Lui (1) require the addition, on a dry rubber mixing mill, of the quantities and types of pigments and dyestuffs shown in Table No. 1 to 17 parts by weight of clean and only light coloured rubber in the presence of $2\frac{1}{2}$ parts by weight of damar resin and a small proportion of peptising agent. At the completion of the milling cycle, the mixed stock is cut into small pieces and dissolved in 100 parts by weight of mineral turpentine.

Table No. I

Pigment/Dyestuff Used.	Proportion of Pigments etc. Required for Paints of Colour.			
	Red	Black	Blue	Yellow
I.C.I. Post Office Red 14526	4			$\frac{1}{2}$
I.C.I. Waxoline Rhodamine B.S.	$\frac{1}{2}$			
Carbon Black (M.P.C.)		2		
I.C.I. Waxoline Nigrosine N.S.		$\frac{1}{2}$		
I.C.I. Blue 24386			3	
I.C.I. Waxoline Blue A.S.			$\frac{1}{2}$	
I.C.I. Lemon Chrome 22599				$3\frac{1}{2}$
I.C.I. Waxoline Orange Y.S.				$\frac{1}{2}$

3. Experimental:

Under Ceylon conditions the principal interest at present in improved R.S.S. bare-back bale paints is for the production of different coloured (red, black, blue, green and yellow) grade marks on the rubber shipped to Chinese ports rather than

for T.C.R. marks, and the preliminary trials, described below, were carried out mainly in 1954 and 1955. For this purpose the weights of pigment and dyestuffs quoted were milled into 17 parts by weight of good quality crepe on a dry rubber mixing mill in the presence of $\frac{1}{2}$ part (of R.P.A.3 or) of Pepton 22D. The cooled milled stock was cut into small pieces and dissolved in about 80 parts by weight of low aromatic white spirit. Fuller details for the preparation of the paints are given at the end of this section.

RED PAINT.—The recipe given in Table No. 1 involves the use of 4 parts of I.C.I. post office red 14526 and $\frac{1}{2}$ part of I.C.I. waxoline rhodamine B.S. and the resulting surface and penetration colour was originally considered more suitable for the T.C.R. mark than for the purpose in mind in Ceylon. An alternative dyestuff, I.C.I. waxoline red O.S. available at a lower price in Ceylon, was therefore tried alone but the preferred recipe was 4 parts of I.C.I. post office red 14526 with 3 parts of I.C.I. waxoline red O.S. Two lots of 100 bales with marks painted according to this recipe were despatched to Asian ports, but, as the limited information received from the buyers of these bales suggested that the details of the experiment has not been adequately understood, a further two lots of about 40 bales each were despatched to European ports. The buyers of both the latter lots reported very favourably on the legibility and external appearance of the experimental bale markings; however, one buyer suggested that the depth of penetration of the dyestuff, *e.g.*, to at least one sheet beyond the inner wrapper might be too great for some purposes. It is understood that complaints of this nature have also been made against alternative experimental recipes tested outside Ceylon and that upto the present complaints of excessive penetration have only been made against the use of red or purple penetrating dyestuffs. A number of alternative recipes and painting procedures have recently been tested with the assistance of a Colombo Packer by storing fully processed and painted bales for about $2\frac{1}{2}$ months in the Packer's Stores prior to re-examination of the bale contents. From the information available it is concluded that larger scale tests with the recipe 4 parts of post office red 14526 and $\frac{1}{2}$ part of I.C.I. waxoline red O.S. would probably be worthwhile, provided that the bale marks are applied only lightly, *i.e.* without an excess of paint. The surface colour obtained with this paint although quite distinct is not perhaps as vivid as might be desired and the possibilities of alternative pigments are still being examined. Further reduction in the quantity of dyestuff may be undesirable unless a substantial improvement in the adhesion of the underlying coatings can be obtained.

The experiments mentioned above suggested, but due to their design did not with certainty establish, that the intensity and probably the depth of penetration of a red paint involving the use of $\frac{1}{2}$ or $1\frac{1}{2}$ parts of waxoline red O.S. can be reduced if the wrapper is coated and painted about 3 weeks before application to the bale. Presumably the lateral spreading of the penetrating dyestuff beneath the coating before the application of the wrapper to the bale leads to the establishment of a lower dyestuffs concentration gradient and hence to less vertical penetration into the bale in a given time interval. While it is questionable whether this observation will have a practical application in many cases, later small scale experiments did suggest that this reduction in penetration, obtained by prior storage of the painted wrappers, can be appreciable. It should also be recorded that while appreciable lateral spreading of a penetrating dyestuff can be seen on the wrapper beneath the coating after a period of storage, significant distortion of the original markings on top of the coating, due to lateral spreading on top of rather than beneath the coating, has not so far been observed.

BLACK PAINT.—The recipe suggested in Table No. 1 involves the use of 2 parts of M.P.C. grade carbon black with $\frac{1}{2}$ part of I.C.I. waxoline nigrosine N.S. Early

small scale experiments with I.C.I. waxoline nigrosine N.S. and with an alternative dyestuff, I.C.I. waxoline nigrosine B.A., appeared to suggest that neither of these dyestuffs possessed much penetration power at the above concentration, and, when used alone in appreciable amounts, both tended to produce tacky films particularly on English white coatings. The use of the pigment carbon black alone or with only quite small proportions of dyestuff was also not considered to be entirely satisfactory on the grounds of poor adhesion to the bale coating, and under our conditions the stocks used in all paints based upon carbon black mixtures should preferably be given extra milling to ensure thorough dispersion. Inadequate milling tends to promote settling out of the black from the final paint solution. The early preferred recipe was based upon the use of $1\frac{1}{3}$ parts of carbon black, $\frac{2}{3}$ part of I.C.I. waxoline nigrosine N.S. with 1 part of I.C.I. waxoline green G.S. Waxoline green G.S. is a deep green which shows appreciable penetration to a greenish-black and as such seemed suitable for further testing in conjunction with a black pigment. This preferred recipe was tested on 30 bales despatched to European ports and the buyers comments did not indicate any undesirable properties such as illegibility or excessive penetration. However, as the buyer concerned did not comment adversely upon the use of 3 parts of I.C.I. waxoline red O.S. in the red paint it is questionable whether the depth of penetration of the dyestuff in this black paint was adequately examined, or, if it was, this buyer may not be concerned with excess penetration in the usual sense. More recent small scale tests involving visual estimates of the depth of penetration under certain accelerated type storage tests seem to imply that the recipe M.P.C. type carbon black $1\frac{1}{2}$, I.C.I. waxoline nigrosine N.S. $\frac{1}{2}$ and I.C.I. waxoline green G.S. $\frac{1}{4}$ would be suitable for larger scale examination by Packers in Ceylon. Improved black paints made outside Ceylon have been commented upon unfavourably in the literature on the grounds that the markings are at times insufficiently distinct, and as none of the improved black paints examined to date have a glossy surface it would appear to be desirable to ensure that the coating composition is of good quality in order to minimise smearing of the bale coating powder over the bale marks.

BLUE PAINT.—The recipe given in Table No. 1 involves the use of 3 parts of I.C.I. blue 24386 with $\frac{1}{2}$ part of I.C.I. waxoline blue A.S. Early small scale laboratory tests with this recipe have suggested that (a) the surface colour of the paint is a distinctive pale blue, which is considered preferable to the deeper blackish blues readily obtained with certain alternative pigments and dyestuffs, but which is nevertheless rather pale, (b) the penetration power of the dyestuff at this concentration is not very great even after 16 months storage of the coated and painted wrapper, (c) the penetration colour of the dyestuff is nearer green than blue and that (d) presumably by virtue of the low penetration power and small proportion of the dyestuff used, the adhesion of the paint to the coating is not as good as might be desired. A substantial increase in the proportion of dyestuff is not recommended as the paint then tends to be slightly tacky on English white coatings, and, according to the literature, there is a risk that the use of paints incorporating some penetrating type blue dyestuffs may lead to 'heating' of the rubber. The information at present available does not suggest that small proportions of waxoline blue A.S. should lead to difficulties of this nature but it will be apparent that a measure of caution is necessary in the initial commercial scale testing of new blue paints. Alternative blue paints based upon the use of waxoline sky blue S.E.S. and waxoline victoria blue B.N.S. have been examined in small scale laboratory tests and at present the preferred recipe is I.C.I. blue 24386 $2\frac{1}{2}$ parts, I.C.I. waxoline blue A.S. $\frac{1}{2}$ part and I.C.I. waxoline victoria blue B.N.S. $\frac{1}{4}$ part. This recipe has not yet been tested commercially but it is concluded that larger scale tests would probably be worthwhile.

YELLOW PAINTS.—The recipe given in Table No. 1 involves the use of $3\frac{1}{2}$ parts of I.C.I. lemon chrome 22599, $\frac{1}{4}$ part of I.C.I. post office red 14526 and $\frac{1}{2}$ part I.C.I. waxoline orange Y.S. Lemon chrome 22599 was withdrawn from the selling range some time ago and the preliminary experiments described in Information Leaflet No. C/56/3 were based mainly upon the use of lemon chrome 24637. Since the circulation of this Leaflet lemon chrome 24637 has also been withdrawn, and, following the advice of the manufacturers, small scale trials have been made with vynamon yellow 6 G.S. and with lemon chrome 3 G.N.S. Up to the present neither of these materials has been found to be entirely satisfactory due to a tendency to tackiness on English White coatings and to a tendency to colour instability. Recent information from the R.R.I. of Malaya indicates that their yellow paints are now based upon vulcafor fast yellow G.T.S. in conjunction with I.C.I. waxoline orange Y.S. and appropriate recipes are now being examined.

GREEN PAINT.—Table 1 involves no recipe for green paints but various suggestions were made by the suppliers of the dyestuffs and of the pigments, and as a result of laboratory tests it is tentatively concluded that the formula vulcafor fast yellow 2 G.S. 2 parts, vulcafor fast blue G.S. 1 part, I.C.I. waxoline green G.S. $\frac{1}{4}$ part and waxoline yellow A.D.S. $\frac{1}{2}$ part should be examined in slightly larger scale trials.

PREPARATION AND APPLICATION OF THE PAINTS.—The base formula used is 17 parts by weight of clean and only lightly coloured natural rubber, preferably pale crepe, with $\frac{1}{2}$ part of Pepton 22 D (or of RPA. 3) and the appropriate quantity of this rubber is added to operating heated (70°C) rubber mixing and sheeting mills. When a continuous band has formed on the front roller the peptising agent (Pepton 22 D or RPA. 3) is slowly added to the rubber and the mixing continued with small mixing mills for about a further 1 to 2 minutes. At this stage the appropriate quantity of the correct pigments (*see* Table No. 2 where the pigments may be identified as the chemicals not having the term 'waxoline' in their names) is slowly added to the band of rubber on the front roll of the mill and the homogenisation of the stock is assisted by cutting away the band to $\frac{2}{3}$ of its width at least twice each side. With small mills this stage will usually be completed in a further $2\frac{1}{2}$ — $3\frac{1}{2}$ minutes, except in the case of carbon black when at least 4 minutes may be required. The dyestuff may then be added and the rolls slightly cooled. The final homogenisation is accomplished with a further 2 cuts each side and preferably with the compound cut off rolled up and inserted end-wise at least once into a fairly narrow nip. The final sheeting out should not be done too thick. The final homogenisation of the dyestuff can usually be completed in about 2—3 minutes with small mills. [The times and cycle of operations given here are necessarily somewhat tentative and depend upon the characteristics of the mills and the size of charge used etc. In principle, excess milling should be avoided as the final colour may sometimes be influenced unduly, but inadequate milling can assist the pigment to settle out of the final paint solution. Packers whose staffs are not experienced in this subject are invited to request the services of the R.R.I.C. in an advisory capacity in this connection].

At the conclusion of the milling, the mixed compound is allowed to cool, cut into pieces about 2" square and dropped into the appropriate quantity of low aromatic white spirit so that the final solution is suitable for brushing. [At R.R.I.C. about 80 parts by weight of solvent is generally used per 17 parts of rubber originally taken; in metric *c.g.s.* units this is about 100 parts by volume of solvent to 17 parts by weight of rubber.] The mixture is then stirred slowly and continuously for about half an hour, corked and allowed to stand overnight. The next morning the

mixture is restirred for upto 60 minutes, but usually less depending upon the proportion of inadequately dispersed lumps of coloured crepe. The paint solution should be ready for use about $1\frac{1}{2}$ days after the commencement of dissolution, but paints with lumps of undissolved rubber should not, of course, be issued for use. For preference paints should be used soon after preparation, but where storage is necessary this is best carried out in wide-mouth, well stoppered bottles stored away from heat and sunlight. Stored paints should be stirred well before use and, if necessary, a little extra solvent may be added. Properly prepared paints can be applied with paint or stencil brushes, but the paints should be applied lightly to minimise the risks of smudging and of excessive penetration. The paints should not be applied to wet coatings and should be given sufficient time to harden on the coating. Stored paints frequently require a longer drying time.

4. Summary and Comments:

The previous article in this series drew attention to a number of the factors which might lead to valid complaints concerning the illegibility of the marks on some of Ceylon's R.S.S. bare-back bales, discussed the importance of the quality, type and relative proportions of the ingredients of the coating solution and indicated the methods by which the visual appearance of a number of the coatings seen in Packing Houses might be improved. This article draws attention to the theoretical and actual defects of bale marking inks based upon water dispersible materials and summarises the relatively recent developments in Indonesia and Malaya leading to the introduction of bare-back bale marking paints based upon the use of pigments and penetrating type dyestuffs in natural rubber solutions. These pigments and dyestuffs are dispersed in the natural rubber by milling, the resultant mixed stock being dissolved in a suitable solvent to obtain a consistency intended for painting. More detailed directions are given, at the end of Section 3 of this article, for the preparation and application of these improved paints and Section 3 also includes an extensive description of much of the laboratory and commercial scale work carried out on this subject at R.R.I.C., and in Colombo and Galle with the assistance of the relevant Packers. It should be appreciated that the best results should not necessarily be expected from these paints when only poor quality coatings are used (3, 5). Subject to the comments in the last paragraph of this Section, it is suggested that Packers should obtain some personal experience with the preparation, application and possibilities of these improved paints on initially a small commercial scale. For reasons of economy Packers may wish to use the improved paints only for the more important markings on the bales in their initial experiments, and, as implied above, improved bale coatings might most suitably be employed beneath these markings.

As noted above the paints suggested for further examination in Ceylon may be prepared according to the procedure at the end of Section 3, whereby the proportions by weight of pigments and dyestuffs shown in Table No. 2 are milled into 17 parts by weight of clean, dry pale crepe, the whole mixed stock being properly dissolved, after shredding, into about 80 parts by weight of low aromatic white spirit. The paints should be applied only lightly.

Table No. II

Pigment/Dyestuff Used.	Proportion of Pigments etc. Required for Paints of Colour.			
	Red	Black	Blue	Green
I.C.I. Post Office red 14526	4			
I.C.I. waxoline red O.S.	$\frac{1}{2}$			
Carbon Black (M.P.C grade)		$1\frac{1}{3}$		
I.C.I. waxoline nigrosine N.S.		$\frac{1}{2}$		
I.C.I. waxoline green G.S.		$\frac{1}{4}$		$\frac{1}{4}$
I.C.I. blue 24386			$2\frac{1}{2}$	
I.C.I. waxoline blue A.S.			$\frac{1}{2}$	
I.C.I. waxoline victoria blue B.N.S.			$\frac{1}{4}$	
I.C.I. vulcafor fast yellow 2 G.S.				2
I.C.I. vulcafor fast blue G.S.				1
I.C.I. waxoline yellow A.D.S.				$\frac{1}{2}$

In connection with Table No. 2, Packers are reminded that the recipes implied therein are offered in all good faith, but the selection of a particular recipe for large scale use from a number of alternatives examined on a small scale is not easy. For this reason semi-commercial scale trials prior to the large scale adoption of any particular recipe are strongly recommended and the R.R.I.C. is prepared, under its normal terms of reference, to demonstrate to a limited number of Packers in their Stores the method of application and type of markings obtained with these paints. Subject to prior commitments and the availability of the necessary raw materials, the R.R.I.C. would expect to be able to offer small quantities of various ready-made paints to limited numbers of Packers for the purpose of assisting them to carry out a restricted number of initial tests in the manner suggested at the end of the first paragraph of this Section. Packers are also reminded that, although very lightly penetrating dyestuffs may become available at a later date, the paints made according to the recipes summarised in the Tables in this article should normally be used only for R.S.S.

5. Acknowledgements:

Grateful acknowledgement is made to Messrs. C. W. Mackie & Co., Ltd. and to Messrs. Chas. P. Hayley for assistance in testing various paints and to Messrs. Imperial Chemical Industries (Export), Ltd. for assistance and advice in the matter of the supply and use of certain pigments and dyestuffs.

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SOIL ANALYSIS—AN AID TO BETTER FARMING

By

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The usefulness and productivity of soils are qualities that vary from farm to farm and from field to field. Some of the differences between soils are due to differences in situation, in mineral matter, or the climate to which the soils have been exposed; others are due to past history and treatment; and others again to soil structure, acidity, mineral nutrients, organic matter and the effects of weather. With so many causes for difference, it is not surprising that there should be no simple way of assessing soils or of measuring differences between them. In advisory work, field observations, field experiments and laboratory examination of soils are the chief means used, and the ultimate assessment depends on the skill and experience of the investigator.

In the field, visual and physical characters, imposed on the soil during its history, can be used to assess root range, moisture disposal, aeration, structure, organic matter and texture, and also the need for drainage or for special cultivation such as deeper ploughing and sub-soiling to break up pans. With the aid of a 'soil indicator', the distribution of acidity, both laterally and with depth, can be roughly mapped. The appearance of crops is often a valuable guide to nutritional and physical defects in the soil. It is thus possible, in the field, to assess the quality of a soil and its suitability for various purposes. Good and poor qualities in soils are easy to recognize by these methods, for they are associated with well-marked soil characters, so that the cause of poor cropping can very often be found without further examination. Where, however, the diagnostic characters are not well-developed, or are confused by treatments, there can be much uncertainty as to their meaning, which skill and experience in interpretation can lessen but cannot overcome.

A measure of the requirements of crops and soils and of the value of treatments may be obtained from field experiments, but the results are not always easy to apply to another set of soil and cultural conditions. A partial remedy is to be found in more experiments on each of the main soil types over a number of seasons; but an average result based on such experiments cannot answer problems entirely or even most effectively, since predictions may be upset by seasonal conditions, the level of farming and local variability in the soil type.

Methods of physical and chemical examination of soils have been developed for research into the nature and properties of soils. Some of these methods have proved suitable for fertility studies and have been extensively used in advisory work. Although these methods have precision in the laboratory and although results are presented as figures, they have, in reality, no greater accuracy in assessing soil properties and requirements than the field methods; they must be calibrated against field observations on crops and soils and against field experiments. Like field

experiments, they suffer from uncertainty whether or how far they apply to a range of soil types and whether or how far soils change appreciably from season to season. Answers to these questions are continually being sought, but progress must be slow in areas of many soil types and many different crops.

There are indications that different soil types require different methods of analysis and this circumstance accounts, in part, for the fact that methods are not uniform throughout the country. Seasonal changes are known to occur in soils. Some of the physical changes in structure and tilth are obvious, but apart from these, chemical and biological changes may occur which affect the distribution of mineral salts, the degree of acidity and the availability of nutrients. Methods of soil analysis record these changes in greater or less degree according to the susceptibility to change of the soil fraction or of the particular property that is being examined. In the case of the mineral nutrients, the larger the proportion of the total nutrient that is being assessed, the less likely is this to suffer seasonal change. The methods that change least are probably more suitable for predicting the average condition of the soil and its long-term requirements, whereas methods susceptible to seasonal change may be more suitable for assessing the immediate condition and the requirements of crops. It is for the soil chemist to decide which method best suits the cropping and the soil conditions in his area.

Soil variability, laterally and with depth, may affect the reliability of sampling. This is particularly true of fields that are acid or that have been recently limed, and of areas of marginal land that are being brought into cultivation for the first time. Variability may be slight in fields that have been cropped and cultivated uniformly over a long time. Care and skill in the examination of the soil before sampling, and knowledge of recent treatments—particularly liming, applications of fertilizers and depth of ploughing—may go far to prevent serious errors or to show whether a truly representative soil sample can possibly be taken. Where variation is due to past treatment, a field may be sub-divided into its different areas and these sampled separately; but where it is due to recent treatments, a field may have to be left for a year or more for cultivations and cropping to bring about better mixing.

It is not only soil analysis that is susceptible to variability in the soil. Soil variability is an inherent difficulty in all field experiments, and great care must be taken in the siting of such experiments on a piece of soil that is as uniform as possible. Other sites—the more difficult in advisory work—have to be rejected. Variability emphasizes the need for careful field observation on soils in order to recognize diagnostic characters in them, as a basis for the sound use of soil analysis or of field experimentation.

By comparison with the field experiment, soil analysis has the advantage of speed; hence its main use in practice is for amplifying field information and for directing cultural and manurial treatments to more profitable ends than would otherwise be possible. Clearly no one method of soil examination can prove adequate under the great variety of conditions that are encountered in the field. The well-tried methods must be used in conjunction with and be supplemented by information from any source that may seem of value. Soil analysis should never be regarded as a laboratory expression of the field requirements and behaviour of crops. The information that soil analysis gives is based on the chemical and physical properties of the soil; this must be correlated with the field performance of crops. It is well to remember that such correlation has errors and pitfalls.

It is well known that soil analysis can provide very useful information for the farmer, helping him to avoid crop failures and to increase yields. The use of soil

analysis in this country and elsewhere is considerable. At each of the provincial laboratories of the N.A.A.S. 16,000 or more samples of soil are analysed annually; in each of the larger regional laboratories in Sweden, Denmark, Holland and Germany, from 80,000 to 200,000 samples may be analysed each year.

There has been a demand for still greater numbers of soil samples to be analysed, but experience shows that a mere increase in numbers, without a corresponding increase in the number of people trained in the art of soil examination and sampling, and experienced in the interpretation of analytical and other evidence, may give poor returns or even be misleading. Moreover, much can be done in sizing-up the requirements of a field or a crop without the aid of soil analysis, especially if the history of the field—its previous cropping, cultivations, manuring and liming—is known.

Most of the soil samples analysed at provincial laboratories go through a routine examination for texture, calcium carbonate, acidity (pH), lime-requirement, available phosphate (P) and available potassium (K). One use of the figures is to judge whether crops are likely to fail through acidity or by reason of deficiency of phosphate or potassium. More difficult matters are to estimate the application of lime, phosphate and potash that will ensure a good crop, and to decide whether phosphate or potash should be, or could be, omitted without disadvantage.

The analytical figures are calibrated in two stages, firstly against crop symptoms and soil conditions, and secondly against field experiments on the responses of crops to lime, phosphate and potash. The first step establishes the levels at which crops are likely to *fail* through acidity (pH) or deficiencies of P & K.

The critical pH levels vary widely, viz. over the range 4.8 to 5.8; for instance the figure is about 4.8 for oats and potatoes, 5.3 for wheat and the kales, and 5.8 for barley, lucerne and sugar beet. The critical P & K levels for farm crops occur in the 'very low' and 'low' levels which, expressed in figures, vary according to the method of analysis used.

Many years of observation of crops in the field and many comparisons of soils in normal and poor cropping areas within fields have been required to establish these critical levels; the information has been of considerable value to farmers in all parts of the country.

In the second step, the responses of crops to lime or to different levels of P & K fertilizers are measured. Each experiment tells, as accurately as may be, the responses on a given experimental area in the year of the experiment. If enough experiments are carried out on soils of similar type over a number of seasons, *average* responses for the soils in question are obtained; against these the results of analysis can be calibrated. For a particular field and season, the responses will probably differ from the average—perhaps considerably—depending on the soil conditions when the crop was sown, changes in the soil during the growth and ripening of the crop, temperature conditions and moisture supply. Fields will differ according to the inherent cropping capacity of the land, the better soils responding more than poorer ones to a given rate of fertilizer. The responses fall as the P & K levels in the soil rise and eventually they become nil or even negative. At this point the levels are usually classed as 'high' or 'very high'. Between 'low' and 'high'—i.e. in the range classed as 'medium' and 'medium high'—responses are very variable.

This kind of calibration has to be repeated on other soil types—this is obviously a lengthy business—and a number of crops have also to be examined. Fortunately

it appears that, if the situation for only a few 'key' crops is established, the situation for others can be assessed in relation to them.

When such a scale is used to assess manurial requirements, it is obvious that no great precision in recommended treatments is possible. Something more than average manuring would be recommended for 'very low' levels of P & K, and something less for 'high' and 'very high' levels. Again, for the intermediate levels, the appropriate average manuring might be increased or decreased according to the manuring of previous crops. Where field examination has shown a soil to be of inherently high productive capacity, the overall rate of manuring might be increased, while keeping the ratios of N: P: K unaltered. Conversely, where the soil appears to be of low productive capacity, the rates might be reduced.

So many considerations enter into the problem—soil character, soil analysis, average results of field experiments, previous manuring and, finally, the value of the expected return (each with its own errors of judgment or measurement) that many consider that the safest course is to adopt average manuring, with some increase in cases where deficiency levels are known to occur. Reductions in manuring at the 'high' and 'very high' levels are also debatable, since readily-available reserves in the soil are of value in adverse seasons; they are not usually recommended unless a reduction in expenditure on fertilizers is required, or where it is known that crop yields are being reduced as a result of very high levels, or again where some other nutrient is deficient (*e.g.* magnesium) and the balance with P & K requires to be restored.

Another use for soil analysis is to help guide general fertilizer policy and the formulation of different compound fertilizers for different parts of the country. Even one province can have contrasting conditions and hence different requirements; this is shown by the following selection of analytical figures for the Eastern Province (see Table I below).

According to these figures, Norfolk appears to have a much greater need for potassium than for phosphate, whereas for Essex the needs are roughly equal; for Holland (Lincs.) deficiencies of phosphate and potassium are far less frequent and considerable reserves are common.

Two questions of importance arise from these figures:— 1. Are they a true reflection of the conditions in the countries? 2. How do such conditions and contracts arise—from inherent soil differences, or from different systems of farming or manurial practices?

Table 1

		Percentage Distribution of Analytical Figures for P & K over a six-year period (1948-1954)—arable land only.						Number of Samples
		Very Low	Low	Medium	Medium High	High	Very High	
Norfolk	P ...	21	21	19	21	11	7	16,742
	K ...	76	15	4	2	1.5	1.5	
Essex	P ...	33	22	17	15	8	5	10,702
	K ...	30	33	18	8	4	7	
Holland (Lincs.)	P ...	11	18	17	17	19	18	4,151*
	K ...	3	12	16	17	21	31	

* Four-year period only.

Remembering that methods of soil analysis are calibrated against field observations, experience and experiment, the figures are likely to be representative of the fields sampled. Perhaps 90 per cent of the samples were taken where information on the general level of fertility was desired and the remaining 10 per cent in cases where crop failures had occurred. The figures may therefore be regarded as providing a useful summary of conditions in the counties, but with a bias towards deficiency levels. How these conditions have arisen is too big a question to be discussed here, but it is of interest to note that trends in manuring are in the direction that the analytical figures indicate to be needed.

Sometimes the information provided by a routine analysis of a soil is insufficient, so that other determinations may usefully be made. These are not done blindly, but in relation to the field evidence on soil characters and crop symptoms, manuring and crop removals. Whenever something new is to be attempted, the method must be put through the same process of examination as is applied to the routine methods and, in an area of many different soil types and crops, this takes a long time. In the Eastern Province, we have been interested in levels of organic matter and nitrogen in soils where the levels of organic matter are visibly low and where, as a result, both the physical properties of soils and crop performance appear to suffer. Some very low levels of organic matter have been found of the order of 1-2 per cent as compared with 3-4 per cent in similar soils in other areas. On occasion figures have been as low as 0.5 per cent. Such very low levels of organic matter are typical of subsoils and the question arises whether they contribute appreciably to the problems of the area.

How far is organic matter important in crop production? When experiments carried out with organic matter in this country are considered, no marked benefit to crops has been obtained from applications of such materials. But it would appear that only one of the experiments in question was carried out on a soil of very low organic matter content; the rest were on soils containing, as judged by advisory experience, adequate or more than adequate amounts of organic matter. No answer is therefore available from field trials.

Should one recommend a change in farming policy with the object of adding more organic matter to the soil? The system of farming associated with these very low levels of organic matter is usually entirely arable, with no leys, the removal of crops and the burning of straw. Such conditions make for a rapid loss of organic matter, while the main return, from the root systems of crops, may not be very great.

It is very difficult to reach a decision on this question in cases where crops are normal and where the nutritional contribution of organic matter has been replaced by increasing use of nitrogenous fertilizer. From time to time, however, the physical properties of these soils are put to the test by adverse weather conditions, and then crops, particularly barley, sugar beet and kale, may suffer badly. Heavy rain, or continuous rain, can destroy tilth, sometimes to a depth of 6-10 inches, leaving a wet and airless mass of soil around the roots, which rapidly deteriorate or die. More organic matter in the soil would do something to reduce the severity of this effect—perhaps sufficiently to save the crop—and would thus be an insurance against a wet season or the occurrence of heavy rainstorms.

If an attempt be made to increase the soil organic matter, by adding bulky manure or crop residues, the process will be found to be slow in any case and probably difficult to achieve on a large scale, as well as being costly. A period under a ley should improve the soil physically and increase its organic matter content, though perhaps only slightly. A ley may be the best method of returning organic matter

and increasing fertility, but it may not be easily or profitably embodied in the farming system. Before an answer can be given to these questions, or thought can be given to the planning of experiments on the value of organic matter, much more information is needed on the causes of low organic matter in soils.

Why is it, for example, that within a field the rate of loss of organic matter has apparently been so much greater in one part than another? Has there been a gradual deterioration in the growth of some of the crops of the rotation in the very low areas, resulting in a diminishing return of root residues? And is the cause nutritional or biological—*e.g.* attack by soil organisms? Has wind or sheet erosion of the soil been the cause?

In one area known to the writer, sugar beet has responded to shoddy (which is a form of protein nitrogen) but not to inorganic nitrogen; here one may, until the contrary is proved, suspect a biological problem.

In such areas of very low organic matter, soil analysis has been used to confirm a soil condition which was suspected from the appearance and physical behaviour of the soil and the symptoms of nitrogen deficiency shown by the crop. The work has revealed weaknesses in our knowledge about the changes taking place in organic matter levels of soils, and about the value of organic matter to crops, and has shown the need for further investigation. Nitrogen determinations have been used as confirmation of the organic matter figures, since in most soils there is a rough relation of 1:17 between them. Unfortunately, nitrogen determinations cannot be used to predict the supply of available nitrogen to crops except so far as to say that it is likely to be very low or very high; and at present this question cannot be satisfactorily answered by analytical methods.

Another determination that has come into greater use in certain areas is that of available magnesium. The removal of magnesium by a particular crop is roughly of the same order as that of phosphorus usually a little less. Some return of magnesium to the soil is made in farmyard manure but none is provided by the commonly used fertilizers and compounds. In time, therefore, soil reserves of magnesium must become depleted and, especially in lighter soils, deficiency levels may be reached. Crops which may be affected are cereals, sugar beet, brassicas, carrots and potatoes. Characteristic and easily recognized symptoms are shown by these crops. Cereals commonly recover and sugar beet may be little affected, but carrots can be very severely damaged; the effects on brassicas and potatoes may be increased by high manuring, particularly when much potassium is present. A high potassium status tends to reduce the uptake of magnesium by plants. A high phosphate status, with chalk in the soil, may increase the risk of magnesium deficiency, because these conditions lower the solubility of magnesium.

The value of soil analysis is to show, in cases where deficiency symptoms have appeared, whether levels of available magnesium are low and, if they are not, whether a high level of potassium, or of phosphate with free chalk, is likely to be the indirect cause. Recommendations on treatment for 'straight' deficiency of magnesium may consist of applications of magnesium sulphate, magnesian limestone or magnesian kainit; where, however, deficiency has been partly induced by excess of potassium or phosphate, some reduction in the use of these may be recommended in addition.

These marked interactions between magnesium and potassium, and the effects of phosphate on the solubility of magnesium, make very difficult and slow the calibration of a method of determining available magnesium. The first stage of

establishing deficiency levels has been reached for a few crops. At higher levels, assessment of cause and treatment rests on the levels of P & K, pH, and the severity of the symptoms shown by the crop; hence, to an increasing extent, experience must be the support for the advice that is given.

In 1955, boron deficiency caused considerable damage to sugar beet and other crops in many parts of the country especially on the lighter soils. The incidence of deficiency is very seasonal, being most severe in a dry summer following a wet winter or spring. In this respect it is very like nitrogen deficiency and the cause appears to be similar, the borates which are released from insoluble combinations being, like nitrates, readily taken out of the soil by rain. If renewal is slow, as it may be on light soils of low organic-matter content, then severe deficiency is possible.

Whether soil analysis can cope with such a situation as this remains to be seen. It has so far failed with nitrogen and, as with nitrogen, it may be able only to show the level of total boron in a soil (or some fraction related to the total) without providing information on the amount of boron that will be available at the time when the crop needs it; perhaps spring may be a better time for sampling than autumn or winter. A method of analysis suitable for rapid routine determinations of 'available' boron has yet to be found, but search for one is being made.

The diagnosis of boron deficiency rests mainly on the recognition of its symptoms in the crop and on its response to treatment. Prediction of its occurrence rests mainly on soil characters, such as very low contents of clay and organic matter—which hold the reserves from which borate is most readily released—and a marked tendency towards dryness. The presence of chalk in the soil is also said to lower the availability of boron. Field experiments in Britain have been mostly on the requirements of sugar beet for boron and have failed to show any marked need; presumably, like those with organic matter, the experiments were not made on deficient soils or carried out in years of boron deficiency. For the farmer whose soils show seasonal deficiency of boron, the safe course is to apply a small amount of borax (20-30 lb. per acre) to susceptible crops, remembering that too large a dressing may damage other crops in the rotation.

Soil analysis is again of limited value in assessing available amounts of the remaining trace elements—iron, manganese, copper, zinc and molybdenum—that crops need. It is used successfully for detecting high levels of these elements, and also of aluminium, which are toxic to crops. Examples occur in the field, but are fortunately rare. High levels of manganese are fairly common in sterilized soils, and cause loss of seedling plants in many nurseries; but the special soil problems in horticulture will not be discussed here. Besides identifying the responsible element, soil analysis may give some indication why it is present in toxic amount. The chief causes are high total amounts and also high acidity which, except in the case of molybdenum, usually increases solubility. The liming of acid soils generally reduces the solubility of iron, aluminium and manganese but does not always reduce that of copper or zinc to safe levels.

Deficiency levels of the trace elements in soils are extremely low by comparison with those for P & K, and no satisfactory routine methods of chemical soil analysis exist for them. They can, however, be assessed in many soils by growing a fungus—*Aspergillus niger*—on the soil. Certain strains of this fungus grow less well, and fruit abnormally, when they are deprived of the trace elements, excepting boron. No large-scale development of this method has occurred in advisory work, chiefly because of the ease with which trace element deficiencies can be diagnosed by alternative methods. Recognition mostly rests on crop symptoms, on responses of crops

to injections or sprays of the trace elements, and on the soil characters which are commonly associated with trace-element deficiencies.

Soluble salts seldom occur in the field in sufficient amount to be harmful to crops. Around the coast, however, and particularly since the floods of February 1953, common salt (sodium chloride) has been a hazard to cropping.

It is easy to determine the salt content of a soil, but not always easy to assess the risk of damage to crops or of deterioration in the physical condition of the soil. Very careful and detailed examination of soils in the field is as important as a knowledge of their salt contents or of the need for a calcium salt such as gypsum to overcome harmful physical effects or to prevent their arising.

Throughout this article the fact that no one method of diagnosis is ever fully satisfactory has been stressed. Where salt problems are concerned, this is particularly true. The situation in affected soils is continually changing and knowledge of the history of formation and of the physical and chemical properties of these soils, layer by layer, is required to understand them and predict the way in which change may occur.

SOIL ANALYSIS BY N. H. PIZER

A Commentary by D. H. Constable.

We have reprinted Dr. Pizer's article because we believe that it answers quite a lot of questions that are put to us and because many of his observations so clearly apply to our own conditions.

From time to time we are requested either to take soil samples and to advise as the result of examining such samples, or we are shown analyses obtained from some other institution and asked to advise on the basis of such analysis.

We hope that Dr. Pizer's article will explain why we invariably decline to do so.

It will be noted that soil analysis *by itself* is nothing and means nothing, except as an academic record of certain properties possessed by that soil. The translation of those properties into agriculturally meaningful quantities can only be done after many years of work and experiments over large areas. You will see that at *each* laboratory of the N.A.A.S. 16,000 samples per year are examined while in Europe up to 200,000 per year may be done with at least 2 or 3 such laboratories to each country. I had the pleasure during the summer of 1956 of visiting one such organisation in Holland. There the land survey has reached the point that every field on every farm is being entered on the maps and given its reference number, while full records exist for every field which has been used for any experimental work. All the analysis records go straight onto punched cards on a fully automatic system. By this means all the cards can be sorted and isolated by any of the properties such as "low phosphate", "high potash", "pH 4.5-5.5" etc. Sorting is entirely automatic and may take place at a rate of 10,000 cards per hour or more. The sorted cards may then be restored according to another desired criterion as often as may be needed. They can finally be dropped into a printing machine which automatically types all the details of each card on suitable report forms.

But even with all this apparatus at our disposal soil analysis is only a tool and one which requires an experienced hand to guide it. Because in Ceylon we have not had the staff or facilities to carry out the volume of work needed we have not hitherto made serious attempts to carry out advisory soil analysis. However, with our increasing facilities etc. we are hoping to make a modest start on the problem in the near future.

There are many interesting observations of Dr. Pizer's some of which I should particularly like to bring to the readers' notice.

The fact that there is variability not only between fields and areas but also within fields points out the difficulty of having a "one manure mixture" policy unless such a manure can supply *all* the probable nutrient needs.

One may note that many in England consider the safest course is to adopt average manuring with adjustments to cover the known cases of "deficiencies" and "highs."

The discussion on organic matter is of interest and it should be particularly noticed that none of the claims for the benefits of organic manures has ever stood up to objective trials of which there have been many. Perhaps the finest example is to be seen at Rothamsted where crop yields of plots after 100 years of purely inorganic manuring are higher than those of adjacent plots which have regularly had large farmyard manure applications. On the other hand, as Dr. Pizer points out, only one experiment has ever been carried out on a soil low (deficient?) in Organic matter and so different results might be obtained on such soils, which are however very much in the minority as far as agricultural land is concerned. Finally the remarks about Magnesium are of particular interest to us, potassium is often the villain of the piece but so can plenty of phosphate with chalk be. Planters may say "well we have no chalk so that lets out phosphate", but Saphos Phosphate is 25% chalk so that, particularly where Saphos only or heavy Saphos has been the programme, magnesium deficiency may be expected.

In conclusion we are most grateful to the author and publishers for allowing us to reprint this authoritative article on a matter which is of considerable interest to the industry. It is very interesting too to see the degree to which problems are common to both temperate and tropical zones.

REPORT ON THE USE OF THE KESTREL FERTILISER DISPENSER

By

R. L. Levett and F. W. Hobley.

In these days of constantly increasing labour costs, means must be sought to reduce expenditure wherever possible. The Kestrel Fertiliser Dispenser, originally designed for manuring tobacco in Rhodesia, is now available in Ceylon, and tests carried out over the last two years indicate that this machine will effect a substantial saving in labour when used for manuring clearings up to two years old, and Nurseries.

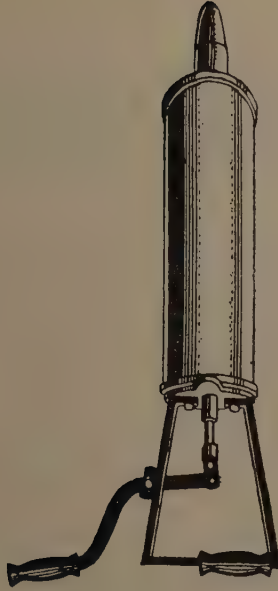
As will be seen from the drawing, the machine consists of a barrel to hold 10 pounds of manure; a tapered nozzle which makes the hole in the ground into which the manure is placed; a fixed handle for holding the machine; and a movable handle, which when depressed, ejects the manure. The machines are supplied with three interchangeable nozzles which regulate the amount of manure ejected. The action is simple—the machine is held in the left hand by the fixed handle, the right hand holding the movable handle for balance. The machine is then pressed into the ground and the right-hand lever is depressed. The machine is then lifted, leaving the manure in the pocket which the nozzle has made.

Two experiments were carried out on different estates in the Kelani Valley; in one experiment two machines were used in young clearings, and in the other one machine was used in Nurseries.

In the young clearings three labourers were employed—two for the machines and one for transport of manure. Two ounces of manure were applied to each plant, and, with the nozzle used, six pockets were placed round each plant ensuring even distribution. The three labourers completed 9 acres a day with ease. Eight applications of manure were made per annum. When this work was done by hand the cost was 1 labourer an acre an application=Rs. 18.40 an acre per annum. Using the Dispenser the cost came to 77 cents an acre an application=Rs. 6.16 an acre per annum. Used for two years in two 25 acre clearings the saving amounted to Rs. 1,224.00, which, less the cost of the two machines @ Rs. 105.00 each, left a net saving of Rs. 1,014.00.

In the Nurseries the Dispenser was used by a labourer permanently employed as a Watcher-cum-weeder. One application of one ounce of manure was placed between every two plants, and the maximum number of plants manured daily was 6,000. This trial was purely from the point of view of convenience, and further trials, employing a team using three Dispensers is being put in hand for a recently laid-down Nursery.

The only breakdown experienced with the machines was due to the corrosive action of manure on the main springs. This is of little consequence however, as this part is cheap and easily replaced.



Note by Editor

The above article is a private contribution and does not necessarily represent the views of the Institute. The Editor has no responsibility in respect of any of the statements or claims made therein.

We would like to point out that though the figures for hand manuring are for 8 applications per year a small but definite profit is still shown by 8 dispenser applications as against 4 hand applications on the figures given. If it is possible to give the greater number of applications and still show a saving over present day costs for the smaller number then the matter is obviously worth further investigation by estates.

The Institute itself is not undertaking any such investigations because this is a question of comparisons of labour management and use which lie outside our general scope and which are, in any case, far more convincingly carried out by commercial concerns.

It is our opinion that for comparable applications the fertiliser dispenser will be as satisfactory from *the nutrient point of view* as hand applications.

A NOTE ON BARK CRACKING OF YOUNG BUDDED TREES OF CLONE PB 86.

By

A. Rikkenbach

PB 86 is undoubtedly the most popular clone for replanting under the Rubber Replanting Subsidy Scheme.

Latex oozing out from cracks in the bark of young trees of this clone causes considerable alarm in the minds of most planters and is such a common complaint in the case of this clone that, it is felt, a short note on this problem would be useful for those concerned.

Bark cracking is a fairly common characteristic of clone PB 86 and should generally give no cause for alarm as the latex coagulating over such wounds acts as a natural barrier to the entry of pathogens into the wounds. The chances of these cracks becoming infected are therefore very small indeed and in practically all cases the wounds heal over naturally.

However, the cracks may be painted over with a 10 to 15 per cent solution of Brunolinum plantarium, after removal of the coagulated latex from the affected areas, using a makeshift brush such as a piece of coconut husk.

On a number of occasions, it has been reported to this Institute that the cracking of the bark in young PB 86 budded trees has led to yellowing of the leaves and sometimes even to the death of the trees. In all such cases our investigations have revealed the fact that the cause of the yellowing of leaves and of the death of the trees is in no way connected to the bark splitting.

This brings out the importance of investigating such problems dispassionately so as to avoid hasty and erroneous conclusions as yellowing of leaves could be due to root disease, inadequate manuring, water logging, infections through the cut end of the snag and to other causes.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 145th meeting of the Rubber Research Board held at the Rubber Controller's Office, Eastern Bank Buildings, Fort, Colombo, at 2-15 p.m. on Tuesday 14th August, 1956.

Present:—Mr. S. Pathmanathan (in the Chair), Senator Thomas Amarasuriya, O.B.E., Mr. G. H. Carter, Mr. G. H. Dulling, Mr. W. P. H. Dias, J.P., Dr. A. W. R. Joachim (Director of Agriculture), Mr. Errol A. Jayawickreme, J.P., U.M., Mr. V. T. G. Karunaratne, M.P., Mr. B. Mahadeva (Rubber Controller), Mr. R. H. Wickremasinghe (Deputy Secretary to the Treasury) and Dr. E. D. C. Baptist (Director).

Messrs. W. I. Pieris (S.H.P.O.) and R. T. Wijewantha (S.H.P.O. Designate) were present by invitation during the consideration of item 5.

1. Board:

The Chairman welcomed Mr. V. T. G. Karunaratne, M.P., who had been nominated to represent the House of Representatives for a period of three years with effect from 15th June, 1956, in place of Major T. F. Jayawardena.

2. Minutes:

(a) *Confirmation*—Draft minutes of the meeting held on 21st May, 1956, which had been circulated to members, were signed by the Chairman.

(b) *Matters arising from the minutes:*

1. *Tenders for buildings*—Nineteen tenders were considered and a contract was awarded to Mr. G. M. Fonseka for the construction of an Asst. Staff Bungalow at Hedigalla.

3. Reports and Accounts:

(a) *Receipts and Payments Account for the 2nd Quarter 1956*—was approved.

(b) *Compulsory redemption of 3½ per cent Ceylon State Mortgage Bank Debentures*—

The Chairman reported that the 3½ per cent Ceylon State Mortgage Bank Debentures value Rs. 250,000/- had been compulsorily redeemed on 4-8-1956 and that the proceeds had been transferred to the Institute's Current Account.

(c) *Pathology Dept. Estimate for Greenhouse*—It was agreed that the vote already provided in the current year's estimate for renovating the greenhouse be deleted and a supplementary vote was passed to cover the cost of a Permutit demineralising plant and a Hot Air Steriliser for the Pathology Dept.

(d) *Supplementary votes*—A supplementary vote was passed to cover the expenditure that would be incurred to carry out certain field experiments by the Pathology Department in connection with Phytophthora Leaf Disease.

4. Staff:

(a) *Director's Service Agreement*—The Director's service agreement prepared by the Board's lawyers, Messrs. F. J. & G. de Saram, was tabled.

(b) *Botanist-Re-engagement*—Agreed that Mr. C. A. de Silva be re-engaged as Botanist for a further term of 4 years and 4 months inclusive of end-of-contract leave.

(c) *S.H.P.O. Designate*—It was reported that Mr. R. T. Wijewantha, S.H.P.O. Designate, had assumed duties on 2nd July, 1956 and that he would get himself acquainted with the work of the Smallholdings Dept. before the retirement of Mr. W. I. Pieris, S.H.P.O.

(d) *Technical Asst. Pathology Dept.*—An application from the Australian High Commission, Colombo, for an extension of Mr. H. L. Munasinghe's scholarship by 6 months was considered. It was agreed that the extension be allowed.

(e) *Asst. and Minor Staff—Changes*—Changes in Assistant and Minor Staff since the last meeting were reported and approved.

(f) *Holidays*—It was agreed that in future Government procedure be followed in declaring holidays for the Institute's staff.

5. Report on Sulphur Dusting of Smallholdings in 1956—The S.H.P.O.'s Report on the Sulphur Dusting Scheme carried out on smallholdings during the 1956 Oidium season was considered and the observations made therein were noted. The Chairman congratulated the S.H.P.O. for his excellent report and thanked him and his staff for the valuable services rendered in making this scheme a success.

6. Visiting Agent:

It was reported that Mr. C. A. C. Bowen, Estate Visiting Agent, had gone on 4 months leave from 14th June, 1956.

7. Publications:

The following publications were tabled:—

1. Combined 3rd and 4th Quarterly Circulars for 1955.
2. Advisory Circular No. 59—Manuring of Rubber.
3. Advisory Leaflet on "Tree Damage".
4. Director's Notes on Natural Rubber Research and Development.

The Chairman brought to the notice of the members that the Director would be issuing a circular on *Phytophthora* shortly.

8. Next Meeting:

It was agreed that the next meeting of the Administrative Committee be held at Dartonfield on Friday, 28th September, 1956 and the next Board meeting be held in Colombo on Monday, 22nd October, 1956.

9. Any Other Business:

(a) *Soil Expert*—It was agreed to invite Prof. F. Hardy, Soil Expert from the Imperial College of Tropical Agriculture, Trinidad, to the Institute when he visits the island next year at the request of Messrs. Gordon Frazer & Co., Ltd., Agents for the Rajawella Produce Co., Ltd.

The meeting then terminated at 4.35 p.m.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 146th meeting of the Rubber Research Board held at the Head Quarters of the Planters' Association of Ceylon, Colombo, at 2-15 p.m., on Monday, 22nd October, 1956.

Present:—Mr. S. Pathmanathan (in the Chair), Mr. H. S. Amarasinghe (Deputy Secretary to the Treasury), Senator Thomas Amarasuriya, O.B.E., Mr. G. H. Carter, Mr. W. P. H. Dias, J.P., Mr. Errol A. Jayewickrema, J.P., U.M., Mr. B. Mahadeva (Rubber Controller), Mr. R. C. L. Notley, Dr. E. D. C. Baptist (Director) and Mr. C. D. de Fonseka (Administrative Secretary).

Mr. L. A. Weerasinghe, Auditor General, was present by invitation.

1. Board:

The following changes in membership were reported:—

- (a) Dr. W. R. C. Paul, Acting Director of Agriculture, had replaced Dr. A. W. R. Joachim who had retired with effect from 18-8-1956.
- (b) Mr. H. S. Amarasinghe, Deputy Secretary to the Treasury, had replaced Mr. R. H. Wickremesinghe with effect from 1-9-1956.
- (c) Mr. R. C. L. Notley had been nominated by the Planters' Association of Ceylon to act for Mr. G. H. Dulling during the latter's absence from Ceylon with effect from 16-8-1956.

The Chairman welcomed Messrs. Amarasinghe and Notley and proposed that Dr. Joachim's valuable services to the Board during his long term of membership be placed on record. Agreed.

2. Minutes:

Draft minutes of the meeting held on 14th August, 1956, which had been circulated to members, were signed by the Chairman.

3. Administrative Committee:

Recommendations made at the meeting held on 28th September, 1956, were approved, one of the recommendations being the approval of a programme of planting and breeding work providing for the appointment of a Plant Breeder and the establishment of three sub-stations in the main rubber growing districts.

4. Smallholdings Committee:

The recommendations made by the Committee at its meeting of 21st September, 1956, were approved.

5. Salaries Committee:

The revised salary scales recommended by the Committee for new entrants were approved and it was agreed that these should come into effect on 1st January, 1957. It was noted that these were very closely in line with the revised salary scales of the Tea and Coconut Research Institutes.

6. Reports and Accounts:

(a) *Report on visit to the Rubber Research Institute of Malaya by the Research Assistant, Agronomy Department*—was tabled.

(b) *Draft Estimates for 1957*—Draft estimates providing for income and expenditure as follows were approved subject to the reservation that the proposed expenditure of Rs. 150,000/- for the construction of a Greenhouse may be incurred only if the proposed increased cess for financing the contribution to the British Rubber Producers' Research Association comes into effect:—

Estimated Expenditure:					
Recurrent	Rs.	1,435,309	
Capital	"	514,267	
					Rs. 1,949,576
Estimated Income	...				" 1,455,144
Excess of Expenditure over Income					Rs. 494,432

(c) *Fixed Deposits*—It was reported that sums of Rs. 250,000/- and Rs. 4,000/- had been placed in fixed deposit at the Bank of Ceylon, Colombo.

7. Staff:

(a) *Research Assistant, Chemical Department*—It was reported that Mr. M. Nadarajah, Research Assistant of the Chemical Department, had left Ceylon on 6th September, 1956, on a Colombo Plan Scholarship for two years at Birmingham University.

(b) *Research Assistant, Botany Department*—It was reported that Mr. L. B. Chandrasekera, Research Assistant of the Botany Department, had left Ceylon on 8th September, 1956, on a Colombo Plan Scholarship for two years at the University of Cambridge.

(c) *Assistant Propaganda Officers, S.H. Department*—It was reported that the service agreements of Messrs. H. H. Peiris and Wilson de Silva, Asst. Propaganda Officers, were due to terminate on 31-1-57 and 31-12-56 respectively and it was agreed that they be offered re-engagement for further periods of four years each on the usual terms.

(d) *Assistant and Minor Staff*—Changes in staff since the last meeting were reported and approved.

8. Exchange of Clones with America:

The exchange of clones with the United States Department of Agriculture on the lines indicated by the Director was approved, and it was noted that the clones

proposed to be introduced are either "breeding clones" or clones which are highly resistant to *Dothidella* and *Phytophthora*.

9. Burmese trainees in rubber planting:

It was noted that two Burmese Government trainees in rubber planting would shortly arrive in Ceylon and it was agreed, at the request of the Ministry of Agriculture and Food, that they be allowed to visit the Institute for a short period after completion of their training on a commercial estate.

10. Publications:

The Annual Report for 1955 was tabled.

11. Next Meeting:

It was agreed that the next meeting of the Board be held at the Tea Controller's Office at 2-30 p.m. on 19th December, 1956.

12. Any Other business:

(a) *Dr. Wiltshire*—In view of the retirement of Dr. S. P. Wiltshire, from the Directorship of the Commonwealth Mycological Institute and from membership of the London Advisory Committee, the Board decided to place on record its deep appreciation of the valuable services rendered by him during his long period of membership of the Committee.

The meeting then terminated.

RUBBER RESEARCH INSTITUTE OF CEYLON

Minutes of the 147th meeting of the Rubber Research Board held at the Tea Controller's Office, Eastern Bank Building, Fort, Colombo, at 2-30 p.m. on Wednesday, 19th December, 1956.

Present:—Mr. S. Pathmanathan (in the Chair), Senator Thomas Amarasuriya, O.B.E., Mr. G. H. Carter, Dr. M. F. Chandraratne (Director of Agriculture), Mr. W. P. H. Dias, J.P., Mr. Errol A. Jayawickrema, J.P., U.M., Mr. V. T. G. Karunaratne, M.P., Mr. B. Mahadeva (Rubber Controller), Mr. R. C. L. Notley, Dr. E. D. C. Baptist (Director) and Mr. C. D. de Fonseka (Administrative Secretary).

The Chairman welcomed Dr. M. F. Chandraratne, Director of Agriculture, who had replaced Dr. W. R. C. Paul on the Board with effect from 7-12-56.

1. Minutes:

Draft minutes of the meeting held on 22nd October, 1956, which had been circulated to members, were signed by the Chairman.

2. Administrative Committee:

(a) *Tenders for Intermediate Staff Bungalow*—The tender of Mr. G. M. Fonseka for the construction of an Intermediate Staff Bungalow at Hedigalla was accepted and the award of a contract to Mr. Fonseka was authorised.

It was also agreed that construction of the bungalow be supervised by the architects Messrs. Billimoria and De Silva Peiris and Panditharatne.

(b) *Bank Accounts*—Agreed that the bank accounts of the Smallholdings and Estate Departments be operated in future as follows:—

Smallholdings Dept.	— Smallholdings Propaganda Officer and Chairman
Estate Dept.	— Estate Superintendent and Director or Administrative Secretary.

(c) *Five Year Programme*—The five year programme of research and development recommended by the Committee was approved subject to certain minor amendments and it was agreed that copies of the programme be sent to the Low Country Products Association, the Planters' Association of Ceylon and the Rubber Controller.

(d) *Clone LCB. 1320*—In view of the authority given by the owners of this clone, the sale of material of this clone without restrictions regarding its multiplication and re-sale within Ceylon was approved, with effect from 1st January, 1957.

Mr. V. T. G. Karunaratne, M.P., came into the meeting at this stage.

3. Reports and Accounts:

(a) *Report of work done during overseas training by the Research Asst. of the Agro Dept.*—This report, which had been circulated to members, was tabled.

(b) *Receipts and Payments Account for the 3rd Quarter 1956*—was approved.

(c) *Audit of Accounts and Auditors' Report for 1955*—In response to a request from the Ministry of Agriculture and Food, it was agreed that the audit of the Institute's accounts be entrusted to the Auditor General with effect from 1956.

(d) *Investments*—The Chairman reported:

1. The transfer of a fixed deposit of Rs. 250,000/- at the Bank of Ceylon to the current account on maturity of the deposit on 7th December, 1956.
2. The investment of Rs. 250,000/- in Ceylon Govt. 3 per cent Loan 1969/72 on 20th November, 1956.

4. Staff:

(a) *Botanist*—Acting arrangements during the absence of Mr. C. A. de Silva on end-of-contract leave were considered and approved.

(b) *Assistant Staff*—Changes in staff since the last meeting were reported.

5. Publications:

The Combined 1st and 2nd Quarterly Circular for 1956 was tabled.

6. Next Meeting:

It was agreed that the next meeting of the Board be held at 2-30 p.m. on 22nd February, 1957.

7. Mr. W. P. H. Dias' visit to Malaya:

Mr. Dias addressed the meeting regarding certain observations he had made on his recent visit to certain rubber estates and smallholdings in Malaya.

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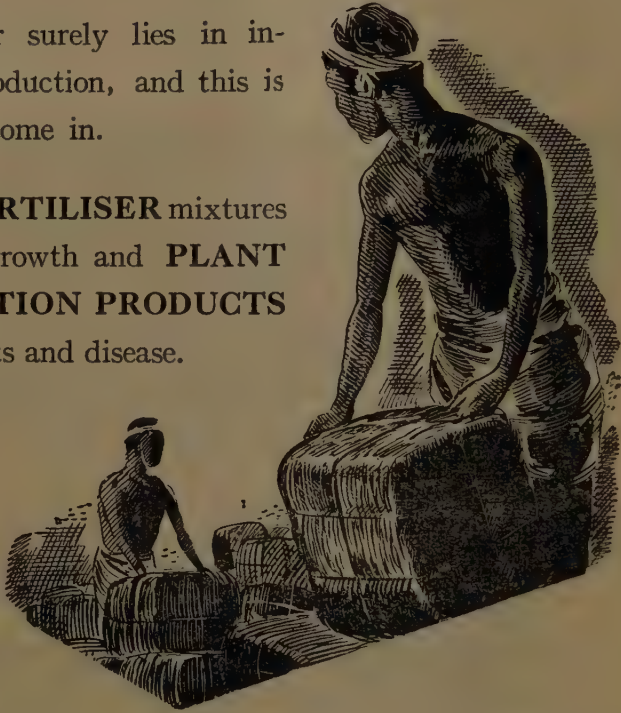
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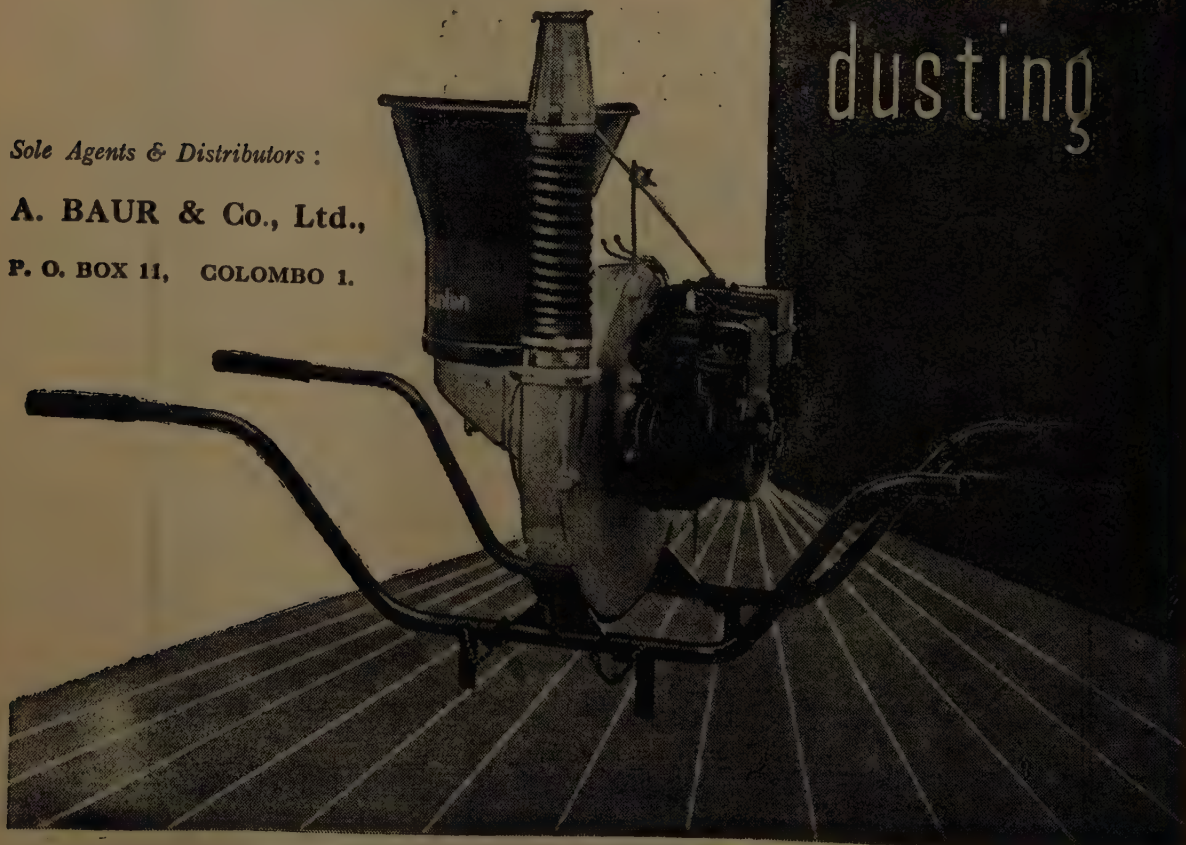
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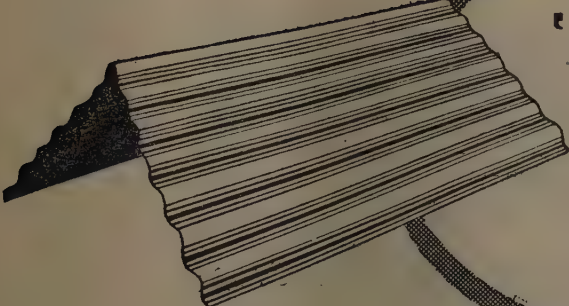
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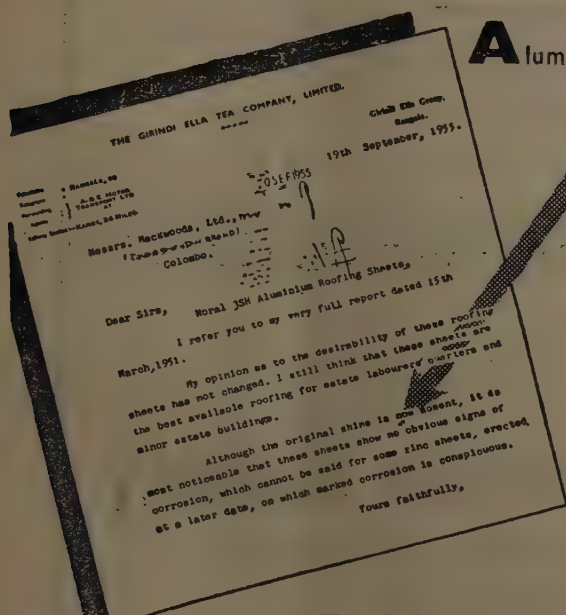
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Chemistry Department	
<i>Chemist</i>	... E. J. Risdon, M.A., D.Phil., F.R.I.C.
<i>Research Assistant</i>	... M. Nadarajah, B.Sc.
<i>Technical Assistants</i>	... D. S. Muthukuda, S. Nathan, M.T. Veerabangsa and G. G. Gnanasegaram.
Botany Department	
<i>Botanist</i>	... G. A. de Silva, B.Sc., C.D.A.
<i>Assistant Plant Breeder</i>	... D. M. Fernando, M.Sc.
<i>Research Assistant</i>	... L. B. Chandrasekera, B.Sc.
<i>Computer</i>	... W. G. V. Fernando.
<i>Technical Assistant</i>	... C. Amaracone.
Plant Pathology Department	
<i>Plant Pathologist</i>	... A. Riggenbach, Dipl. Sc. Nat (ETH), Dr. Sc. Nat (ETH).
<i>Assistant Plant Pathologist</i>	... O. S. Peries, B.Sc.Agr.
<i>Technical Assistants</i>	... H. L. Munasinghe, E. G. Mendis and T. Marcus Fernando.
Agronomy Department	
<i>Agronomist</i>	... D. H. Constable, M.Sc., D.I.C., A.R.C.S.
<i>Research Assistant</i>	... A. J. Jeevaratnam, M.Ag.Sc.
<i>Technical Assistants</i>	... T. Kanthasamy, A. K. Gunadasa, and U.K.D. Lewis.
Estate Department	
<i>Superintendent</i>	... L. Wijeyegunawardena.
<i>Hedigalla Nursery Manager</i>	... H. M. Buultjens.
<i>Senior Field Assistants</i>	... D. C. Kannangara, L. P. de Mel and J. Pitchamuthu.
<i>Head Estate Clerk</i>	... T. S. J. Peiris.
<i>Senior Artisan</i>	... T. C. Fernando.
<i>Clerks (4)</i>	
<i>Rubber Maker, Apothecary, Electrician and Workshop-Foreman.</i>	
<i>Field Assistants (7)</i>	
Smallholdings Department	
<i>Smallholdings Propaganda Officer</i>	... R. T. Wijewantha, B.Sc. (Special) Hons.
<i>Assistant Propaganda Officers</i>	... N. W. Palihawadana, K. Wilson de Silva and H. H. Peiris.
<i>District Field Officers</i>	... D. R. Ranwala, P. S. G. Cooray, D. E. A. Abeywickrema and B. D. Pedrick.
<i>Rubber Instructors (41)</i>	
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Administration	
<i>Administrative Secretary</i>	... C. D. de Fonseka, A.C.C.A., A.C.C.S.
<i>Office Assistant</i>	... J. A. Attygalle.
<i>Senior Accounts Clerk</i>	... H. Kulaseena, A.C.C.S.
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Note.—The Laboratories and Head Quarters Offices of the Institute are situated at Dartonfield Estate, Agalawatta, Telephone No. 26, Agalawatta, Telegraphic Address 'Rubrs' Agalawatta. There are two Experimental Stations, one at Nivigalakele, Matugama, and the other at Hedigalla, Latpandura. The Office of the Smallholdings Department is at No. 33, Clifford Place, Colombo 4. Telephone No. 84205, Colombo.

All enquiries and other communications should be addressed to the Director, Rubber Research Institute of Ceylon, Agalawatta.

